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EXAMINER	
ROSENBERGER, FREDERICK F	
ART UNIT	**PAPER NUMBER**
2884	

DATE MAILED: 02/14/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/688,723	MAY, RANDY DEAN	
	Examiner	Art Unit	
	Frederick F. Rosenberger	2884	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 December 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *03 June 2005* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 2 December 2005 has been entered.

2. Applicant's reply, filed 2 December 2005, has been received and entered. Accordingly, claims 1, 8, 10, 12, 13 and 20 have been amended. Thus, claims 1-20 are currently pending in this application.

Claim Objections

3. Claim 10 is objected to because of the following informalities: In claim 10, line 9, "and" at the beginning of said line should probably be deleted. Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claim 8 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 8 has been amended such that a wavelength for the light source is selected from a group, but applicant has failed to specify a group. See claim 8, line 2. For the purposes of this Office action, the previous wavelength range of 2.711μm to 2.786μm has been assumed.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 1, 3, 10, and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cvetkovic (German Patent Publication # DE-3413914-A1) in view of May (Conference Paper entitled "Next-Generation Diode Laser Gas Sensors for Environmental and Industrial Monitoring").

With regards to claims 1 and 13, Cvetkovic discloses a system for detecting trace amounts of water vapor in natural gas (see applicant submitted English translation, page 3, lines 30-33) comprising:

Optical means in the form of color center laser **1** (Figure 1) as a light source, which emits light at substantially a single wavelength corresponding to a single absorption line at which water molecules absorb light at a substantially greater level than natural gas molecules (applicant submitted English translation, page 3, lines 30-33 and lines 45-47);

Detection means in the form of a detector **10** (Figure 1) configured to detect the intensity of light emitted from the light source; and

Determination means in the form of electronics **7** (Figure 1 and applicant submitted English translation, page 4, lines 36-37) coupled to the detector for determining the level of water vapor in the natural gas.

By virtue of the use of the color center laser, the light source in the disclosure of Cvetkovic would emit a wavelength having a width sufficiently narrow to perform single line spectroscopy.

Cvetkovic do not address the electronics determining the water vapor level using single line harmonic spectroscopy.

However, May teaches that harmonic spectroscopy using tunable laser sources was a popular spectroscopy method for gas sensors. Further, May points out that such techniques are simple to implement and result in straightforward spectral analysis (see page 112, first paragraph under Section 4).

Thus, it would have been obvious for a person having ordinary skill in the art at the time the invention was made to determine the water vapor level using harmonic spectroscopy since it was known in the art that such techniques are often used with

tunable laser source gas sensors. Further, it would have been obvious to use harmonic spectroscopy to determine the water vapor concentration to take advantage of the simple implementation and straightforward spectral analysis, as taught by May.

With regards to claim 3, Cvetkovic discloses a color center laser (applicant submitted English translation, page 3, lines 30-33 and lines 45-47);

With regards to claim 10, Cvetkovic disclose a method for determining trace amounts of water in natural gas comprising the steps of:

Generating light using color center laser **1** (Figure 1) as a light source, which emits light at substantially a single wavelength corresponding to a single absorption line at which water molecules absorb light at a substantially greater level than natural gas molecules (applicant submitted English translation, page 3, lines 30-33 and lines 45-47);

Passing the generated light through a sample of natural gas (Figure 1);

Detecting the light passed through the natural gas using a detector **10** (Figure 1) configured to detect the intensity of light emitted from the light source;

Determining the level of water in the natural gas using of electronics **7** (Figure 1 and applicant submitted English translation, page 4, lines 36-37) coupled to the detector.

Cvetkovic do not address the electronics determining the water vapor level using single line harmonic spectroscopy.

However, May teaches that harmonic spectroscopy using tunable laser sources was a popular spectroscopy method for gas sensors. Further, May points out that such

techniques are simple to implement and result in straightforward spectral analysis (see page 112, first paragraph under Section 4).

Thus, it would have been obvious for a person having ordinary skill in the art at the time the invention was made to determine the water vapor level using harmonic spectroscopy since it was known in the art that such techniques are often used with tunable laser source gas sensors. Further, it would have been obvious to use harmonic spectroscopy to determine the water vapor concentration to take advantage of the simple implementation and straightforward spectral analysis, as taught by May.

8. Claims 1, 2, 5, 6, 10, 13, and 17-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kessler et al. (Conference Paper entitled "Near-IR Diode Laser-based Sensor for ppb-level Water Vapor in Industrial Gases") in view of May (Conference Paper entitled "Next-Generation Diode Laser Gas Sensors for Environmental and Industrial Monitoring").

With regards to claims 1 and 13, Kessler et al. disclose a system for detecting trace amounts of water vapor in natural gas (see abstract, line 11) comprising:

> Optical means in the form a tunable diode laser light source (page 144, section 2.1), emitting light at substantially a single wavelength corresponding to a single absorption line at which water molecules absorb light at a substantially greater level than natural gas molecules;

Detection means in the form of an InGaAs photodiode detector (page 144, section 2.1), configured to detect the intensity of light emitted from the light source;

Determination means in the form of computer module and data acquisition electronics (page 144, section 2.2) coupled to said detector for determining the level of water vapor in the natural gas;

Kessler et al. does not specifically address the electronics determining the water vapor level using single line harmonic spectroscopy.

However, May teaches that harmonic spectroscopy using tunable diode lasers was a popular spectroscopy method for gas sensors. Further, May points out that such techniques are simple to implement and result in straightforward spectral analysis (see page 112, first paragraph under Section 4).

Thus, it would have been obvious for a person having ordinary skill in the art at the time the invention was made to determine the water vapor level using harmonic spectroscopy since it was known in the art that such techniques are often used with tunable laser source gas sensors. Further, it would have been obvious to use harmonic spectroscopy to determine the water vapor concentration to take advantage of the simple implementation and straightforward spectral analysis, as taught by May.

With regards to claims 2 and 17, Kessler et al. disclose a tunable diode laser (page 144, section 2.1).

With regards to claim 5, Kessler et al. disclose an InGaAs photodiode (page 144, section 2.1).

With regards to claim 6, Kessler et al. disclose a means for calibration of the system relative to known concentrations of water vapor (pages 145-146, section 4).

With regards to claim 10, Kessler et al. disclose a method for determining trace amounts of water in natural gas, comprising the steps of:

Generating light at a single wavelength using a tunable diode laser (page 144, section 2.1), which emits light at substantially a single wavelength corresponding to a single absorption line at which water molecules absorb light at a substantially greater level than natural gas molecules;

Passing the generated light through a sample of natural gas (see abstract, line 11);

Detecting the light passed through the gas using an InGaAs photodiode (page 144, section 2.1);

And determining the level of water within the natural gas based on the level of detected light using a computer module and data acquisition unit (page 144, section 2.2).

Kessler et al. does not specifically address the step of determining the water vapor level using single line harmonic spectroscopy.

However, May teaches that harmonic spectroscopy using tunable diode lasers was a popular spectroscopy method for gas sensors. Further, May points out that such techniques are simple to implement and result in straightforward spectral analysis (see page 112, first paragraph under Section 4).

Thus, it would have been obvious for a person having ordinary skill in the art at the time the invention was made to determine the water vapor level using harmonic spectroscopy since it was known in the art that such techniques are often used with tunable laser source gas sensors. Further, it would have been obvious to use harmonic spectroscopy to determine the water vapor concentration to take advantage of the simple implementation and straightforward spectral analysis, as taught by May.

With regards to claims 18 and 19, Kessler et al. disclose a multipass Herriott cell (page 144, section 2.3) and a means for supplying a flow of natural gas to the Herriott cell and thus across the light source.

9. Claims 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kessler et al. and May, as applied to claim 1 above, and further in view of Inman et al. (US Patent # 6,188,475).

The combination of Kessler et al. and May disclose all the limitations of parent claim 1, as addressed above. However, the combination does not address that the light source is either a color center laser or a quantum cascade laser. Instead, Kessler et al. only discuss the use of tunable diode lasers.

Inman et al. teach an in-line cell for absorption spectroscopy that employs a diode laser source to emit light at a wavelength characteristic of the impurity within the sample gas. For the light source, Inman et al. employ a tunable diode laser (column 5, lines 51-58). Inman et al. further point out that other suitably sized tunable lasers, such

as fiber lasers or quantum cascade lasers, are equivalent to the tunable diode laser for absorption spectroscopy (column 6, lines 40-45).

Therefore, because these tunable lasers were art-recognized equivalents at the time the invention was made, one of ordinary skill in the art would have found it obvious to substitute a color center laser or a quantum cascade laser for a tunable diode laser.

10. Claims 7-9, 11, and 14-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kessler et al. and May, as applied to claims 1, 10, and 13 above, and further in view of Murray, Jr. et al. (US Patent # 5,107,118).

The combination of Kessler et al. and May disclose all the limitations of parent claims 1, 10, and 13, as described above. However, the combination is silent with regards to the claimed wavelength ranges for the light sources. Instead, Kessler et al. discuss spectroscopy in the vicinity of the 1.3525μm absorption peak. Kessler et al. do take recognize that the host gas (ammonia as detailed in the body of the paper) could interfere with the measurement through absorption at the same wavelength as water vapor absorption (see top of page 144).

Murray, Jr. et al. teach that the desired wavelength range for the absorption based measurement of water vapor in a sample gas is 2710nm to 2747nm, to allow for adequate differentiation between absorption due to water and due to the sample hydrocarbon gas (column 6, lines 32-38).

Thus, it would have been obvious for a person having ordinary skill in the art to use a wavelength range of 2710nm to 2747nm for the emitted wavelength of the laser

source so as to provide adequate discrimination between the host natural gas and the contaminant water, as taught by Murray, Jr. et al. It would have been further obvious to one of ordinary skill in the art at the time the invention was made to use any of the wavelength ranges specified in claims 7, 9, 14, and 16, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ 233.

11. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kessler et al. (Conference Paper entitled "Near-IR Diode Laser-based Sensor for ppb-level Water Vapor in Industrial Gases") in view of May (Conference Paper entitled "Next-Generation Diode Laser Gas Sensors for Environmental and Industrial Monitoring") and Brand et al. (US Patent # 6,064,488).

Kessler et al. disclose a system for detecting trace amounts of water vapor in natural gas (see abstract, line 11) comprising:

A light source, in the form of a tunable diode laser (page 144, section 2.1), emitting light at substantially a single wavelength corresponding to a single absorption line at which water molecules absorb light at a substantially greater level than natural gas molecules;

A detector, in the form of an InGaAs photodiode (page 144, section 2.1), configured to detect the intensity of light emitted from the light source;

Electronics, in the form of computer module and data acquisition unit (page 144, section 2.2) coupled to said detector for determining the level of water vapor in the natural gas;

A means for calibration of the system relative to known concentrations of water vapor (pages 145-146, section 4);

A multipass Herriott cell (page 144, section 2.3);

And a supply line for supplying a flow of natural gas to the Herriott cell and thus across the light source.

Kessler et al. does not specifically address the electronics determining the water vapor level using single line harmonic spectroscopy.

However, May teaches that harmonic spectroscopy using tunable diode lasers was a popular spectroscopy method for gas sensors. Further, May points out that such techniques are simple to implement and result in straightforward spectral analysis (see page 112, first paragraph under Section 4).

Thus, it would have been obvious for a person having ordinary skill in the art at the time the invention was made to determine the water vapor level using harmonic spectroscopy since it was known in the art that such techniques are often used with tunable laser source gas sensors. Further, it would have been obvious to use harmonic spectroscopy to determine the water vapor concentration to take advantage of the simple implementation and straightforward spectral analysis, as taught by May.

Kessler et al. also do not specifically address a sampling shelter for the optical gas sensor.

Brand et al. teach that the apparatus for sensing gas concentrations via gas absorption spectroscopy is housed within enclosure **40** (Figure 2 and column 3, lines 56-60), thus acting as a sampling shelter for attaching the sensor system to the wall **39** (Figure 2) of a stack or pipeline.

Thus it would have been obvious to a person having ordinary skill in the art to provide the sensor system of Kessler et al. and May in a sampling shelter to protect the sensor and allow it to connect to the pipeline of interest for sampling the gas under test, as taught by Brand et al.

12. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kessler et al. and May, as applied to claim 1 above, and further in view of Paige (Conference Paper entitled "Commercial Gas Sensing with Vertical Cavity Lasers").

The combination of Kessler et al. and May disclose all the limitations of parent claim 1, as discussed above. However, Kessler et al. are silent with regards to the light source being a VCSEL. Instead, Kessler et al. employ a tunable diode laser for the light source.

Paige teaches that VCSELs are superior for gas sensing applications because of their wider tuning range, less divergence and rounder beam profile, as well as decreased susceptibility to optical feedback (page 141, first paragraph).

Thus, it would have been obvious for a person having ordinary skill in the art at the time the invention was made to include a VCSEL for the light source to take

advantage of the VCSEL's wider tuning range, lower divergence, rounder beam profile, and decreased susceptibility to optical feedback, as taught by Paige.

With regards to the output range of the VCSEL, Paige teaches that VCSELs are available in wavelength ranges from 750nm to 960nm (page 141, 2nd paragraph). Paige further teaches that water vapor has an absorption line at 945nm (page 141, 3rd paragraph). Thus, it would have been obvious for a person having ordinary skill in the art at the time the invention was made to choose a range around the known absorption line for water vapor of 920nm to 960nm, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. In re Aller, 105 USPQ 233.

Response to Arguments

13. Applicant's amendment of claims 10 and 13 has successfully overcome the objections of claims 10 and 13, as detailed in paragraphs 3 of the Office action mailed 12 August 2005.

14. Applicant's arguments filed 2 December 2005 have been fully considered but they are not persuasive. Applicant makes the following arguments:

A. None of the references suggests detecting moisture in natural gas using a light source, which enables the use of single line harmonic spectroscopy (page 8, last paragraph).

B. Claim 8 should be allowable as none of the references teach the cited range (page 8, last paragraph through top of page 9).

C. Claim 20 should be allowable as none of the references suggest using a VCSEL laser operating at a single wavelength in the range of 920 to 960nm (top of page 9).

15. With regards to argument A, it is first noted that the limitation for the light source of amended claim 1 requires that the light source emit light "at substantially a single wavelength having a width sufficiently narrow to conduct ***single line spectroscopy***..." (emphasis added). There is no requirement in claim 1 or any of the subsequent independent claims that the light source enables the use of single line harmonic spectroscopy. Single line harmonic spectroscopy is a subset of single line spectroscopy wherein the light source is modulated at a high frequency and the detection occurs at a multiple of that modulation frequency.

Second, it is noted that both Cvetkovic and Kessler et al. use the same type of light sources as the applicant's invention (i.e. color center laser and tunable diode laser, respectively). It is unclear from applicant's argument why their use of such tunable laser sources in the cited would not be enabling for single line harmonic spectroscopy.

Finally, the new limitation of single line harmonic spectroscopy has been addressed in the rejections above. Specifically, reference has been made to May, who discloses that harmonic spectroscopy has been used in gas sensors since the invention of tunable diode lasers in the 1970's. Applicant's attention is directed to the references

cited below considered pertinent to applicant's disclosure. Namely, the references to McAndrew et al. and Goldstein et al. teach the use and advantages of harmonic spectroscopy in gas sensing.

16. With regards to argument B, it is noted that the amended claim 8 no longer includes a range for the light source emission. See the rejection of claim 8 under 35 U.S.C. 112, 2nd paragraph above. It is also noted that the wavelength of 2786.51 nm noted in applicant's argument (see top of page 9) falls outside the disclosed range of 2.711 μm to 2.786 μm in applicant's original disclosure.

17. With regards to argument C, this new limitation has been addressed above in the rejection of claim 20. Contrary to applicant's assertion, Paige does teach a VCSEL laser operating at substantially a single wavelength of 945nm.

Conclusion

18. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

McAndrew et al. (US Patent # 5,880,850) disclose a method and system for sensitive detection of gaseous species in a vacuum chamber using harmonic detection spectroscopy.

McAndrew et al. (US Patent # 5,963,336) disclose a method and system for detection of gaseous species in an exhaust line. McAndrew et al. also discuss the advantages associated with harmonic spectroscopy (column 8, lines 55-64).

Goldstein et al. (US Patent # 5,026,991) disclose a method for monitoring gaseous species using harmonic spectroscopy (column 4, lines 11-43).

19. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Frederick F. Rosenberger whose telephone number is 571-272-6107. The examiner can normally be reached on Monday-Friday 8:00 AM - 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Porta can be reached on 571-272-2444. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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